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Claims

1. A method of cutting tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a substantially horizontal axis of rotation and having multiple peripherally mounted rolling cutter units each rotatable about its own axis;

(b) while rotating said cutterhead assembly means about its substantially horizontal axis, plunging said rotating cutterhead assembly means forwardly into the hard rock work face;

(c) while rotating said cutterhead assembly means about its substantially horizontal axis, sweeping said rotating cutterhead assembly across said hard rock work face, the rolling cutter units on the cutterhead assembly means being rotated about their respective axes by contact with the work face and making substantially helical cuts in the work face in the course of transiting the work face, such sweeping action and cutterhead assembly means rotation continuing until the cutterhead assembly means has transited completely across the work face;

(d) while rotating said cutterhead assembly means about its horizontal axis, plunging the rotating cutterhead assembly means forwardly into the hard rock work face;

(e) while rotating said cutterhead assembly means about its substantially horizontal axis, sweeping said rotating cutterhead assembly means back across the hard rock work face, such sweeping action and cutterhead assembly means rotation continuing until the rotating cutterhead assembly means has transited completely across the hard rock work face; and

(f) repeating steps (b), (c), (d), and (e) above.

2. The method of claim 1, wherein said cutterhead assembly means is rotated at a selected rotation rate to give a peripheral velocity of about 400 to 800 feet (120 to 240 meters) per minute.

3. The method of claim 1, wherein said rotating cutterhead assembly means is plunged forwardly into said hard rock work face until the plunge depth is about 0.1 to 4 inches (0.25 to 10 cm).

4. The method of claim 2, wherein said cutterhead assembly means has a radius of about 36 to 84 inches (90 to 215 cm).

5. The method of claim 3, wherein said cutterhead assembly means has a radius of about 36 to 84 (90 to 215 cm) inches, and each rolling cutter unit is a disc cutter having a diameter of about 10 to 18 inches (25 to 45 cm).

6. The method of claim 2, comprising sweeping the cutterhead assembly horizontally in steps (c) and (e).

7. The method of claim 3, comprising sweeping the cutterhead assembly horizontally in steps (c) and (e).

8. A method of cutting mining tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a horizontal axis of rotation and having multiple peripherally mounted disc-like cutter units;

(b) rotating said cutterhead assembly means about its horizontal axis at a selected rotation rate to give a selected peripheral velocity;

(c) plunging said rotating cutterhead assembly means forward into said hard rock until a selected plunge depth is achieved;

(d) sweeping said rotating cutterhead assembly means sideward in a first horizontal direction through said hard rock at a selected sweep rate until a selected width of cut is achieved;

(e) plunging said rotating cutterhead assembly means forward into said hard rock until a selected plunge depth is achieved;

(f) sweeping said rotating cutterhead assembly means sideward in the other horizontal direction through said hard rock at a selected sweep rate until a selected width of cut is achieved; and

(g) then repeating steps (c), (d), (e), and (f).

9. The method of claim 8 wherein said peripheral velocity is between about 400 to 800 feet (120 to 240 meters) per minute.

10. The method of claim 8 wherein said plunge depth is between about 0.1 to 4 inches (0.25 to 10 cm).

11. The method of claim 8 wherein said sweep rate is between about 5 to 120 inches (13 to 300 cm) per minute.

12. The method of claim 8 wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.5 inches (3.2 to 11.5 cm) per revolution.

13. A method of cutting mining tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means

having a horizontal axis of rotation and having multiple peripherally mounted disc-like cutter units;

(b) rotating said cutterhead assembly means about its horizontal axis at a selected rotation rate to give a peripheral velocity between about 400 to 800 feet (120 to 240 meters) per minute;

(c) plunging said rotating cutterhead assembly means forward into said hard rock until a plunge depth between about 0.1 to 4 inches (0.25 to 10 cm) is achieved;

(d) sweeping said rotating cutterhead assembly means sideward in a first horizontal direction through said hard rock at a sweep rate between about 5 to 120 inches (13 to 300 cm) per minute wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.5 inches (3.2 to 11.5 cm) per revolution, until a selected width of cut is reached;

(e) plunging said rotating cutterhead assembly means forward into said hard rock until a plunge depth between about 0.1 to 4 inches (0.25 to 10 cm) is achieved;

(f) sweeping said rotating cutterhead assembly means sideward in the other horizontal direction through said hard rock at a sweep rate between about 5 to 120 inches (13 to 300 cm) per minute wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.25 inches (3.2 to 11.5 cm) per revolution, until a selected cut of width is achieved; and

(g) then repeating steps (c), (d), (e), and (f).

14. A method of cutting tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a substantially horizontal axis of rotation and

having multiple peripherally mounted rolling cutter units each rotatable about its own axis;

(b) while rotating said cutterhead assembly means about its horizontal axis, plunging said rotating cutterhead assembly means forwardly into the hard rock work face;

(c) while rotating said cutterhead assembly means about its substantially horizontal axis, sweeping said rotating cutterhead assembly across said hard rock work face, the rolling cutter units on the cutterhead assembly means being rotated about their respective axes by contact with the work face and making a substantially helical cut in the work face in the course of transiting the work face, such sweeping action and cutterhead assembly means rotation continuing until the cutterhead assembly means has transited completely across the work face;

(d) while rotating said cutterhead assembly means about its horizontal axis, plunging the rotating cutterhead assembly means forwardly into the hard rock work face;

(e) stopping the rotation of said cutterhead assembly means and then rotating said cutterhead assembly means in the reverse direction of rotation;

(f) while rotating said cutterhead assembly means about its substantially horizontal axis, sweeping said rotating cutterhead assembly means back across the hard rock work face, such sweeping action and cutterhead assembly means rotation continuing until the rotating cutterhead assembly means has transited completely across the hard rock work face; and

(g) repeating steps (d), (e) and (f) above.

15. The method of claim 14, wherein said cutterhead assembly means is rotated at a selected rotation rate to

give a peripheral velocity of about 400 to 800 feet (120 to 240 meters) per minute.

16. The method of claim 14, wherein said rotating cutterhead assembly means is plunged forwardly into said hard rock work face until the plunge depth is about 0.1 to 4 inches (0.25 to 10 cm).

17. The method of claim 15, wherein said cutterhead assembly means has a radius of about 36 to 84 inches (90 to 215 cm).

18. The method of claim 16, wherein said cutterhead assembly has a radius of about 36 to 84 inches (90 to 215 cm), and each rolling disc-like cutter unit is a disc cutter having a diameter of about 10 to 18 inches (25 to 45 cm).

19. The method of claim 15, comprising sweeping the cutterhead assembly horizontally in steps (c) and (f).

20. The method of claim 16, comprising sweeping the cutterhead assembly horizontally in steps (c) and (f).

21. A method of cutting mining tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a horizontal axis of rotation and having multiple peripherally mounted disc-like cutter units;

(b) rotating said cutterhead assembly means about its horizontal axis at a selected rotation rate to give a selected peripheral velocity;

(c) plunging said rotating cutterhead assembly means forward into said hard rock until a selected plunge depth is achieved;

(d) sweeping said rotating cutterhead assembly means sideward in a first horizontal direction through said hard rock at a selected sweep rate until a selected width of cut is achieved;

(e) plunging said rotating cutterhead assembly means forward into said hard rock until a selected plunge depth is achieved;

(f) stopping the rotation of said cutterhead assembly means and then rotating said cutterhead assembly means in the reverse direction of rotation;

(g) sweeping said rotating cutterhead assembly means sideward in the other horizontal direction through said hard rock at a selected sweep rate until a selected width of cut is achieved; and

(g) then repeating steps (e), (f), and (g).

22. The method of claim 21 wherein said peripheral velocity is between about 400 to 800 feet (120 to 400 meters) per minute.

23. The method of claim 21 wherein said plunge depth is between about 0.1 to 4 inches (0.25 to 10 cm).

24. The method of claim 21 wherein said sweep rate is between about 5 to 120 inches (13 to 300 cm) per minute.

25. The method of claim 21 wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.5 inches (3.2 to 11.5 cm) per revolution.

26. A method of cutting mining tunnels in hard rock, comprising the steps of:

(a) providing a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a horizontal axis of rotation and having multiple peripherally mounted disc-like cutter units;

(b) rotating said cutterhead assembly means about its horizontal axis at a selected rotation rate to give a peripheral velocity between about 400 to 800 feet (120 to 240 meters) per minute;

(c) plunging said rotating cutterhead assembly means forward into said hard rock until a plunge depth between about 0.1 to 4 inches (0.25 to 10 cm) is achieved;

(d) sweeping said rotating cutterhead assembly means sideward in a first horizontal direction through said hard rock at a sweep rate between about 5 to 120 inches (13 to 300 cm) per minute wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.5 inches (3.2 to 11.5 cm) per revolution, until a selected width of cut is reached;

(e) plunging said rotating cutterhead assembly means forward into said hard rock until a plunge depth between about 0.1 to 4 inches (0.25 to 10 cm) is achieved;

(f) stopping the rotation of said cutterhead assembly means and then rotating said cutterhead assembly means in the reverse direction;

(g) sweeping said rotating cutterhead assembly means sideward in the other horizontal direction through said hard rock at a sweep rate between about 5 to 120 inches (13 to 300 cm) per minute wherein the ratio between the sweep rate and the cutterhead rotation rate is between about 1.25 to 4.25 inches (3.2 to 11.5 cm) per revolution, until a selected cut of width is achieved; and

(h) then repeating steps (e), (f), and (g).

27. A mobile mining machine for cutting mining tunnels in hard rock by horizontal sweeping movements, comprising:

(a) a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a substantially horizontal axis of rotation and having multiple peripherally mounted rolling cutter units;

(b) rotation means for rotating said cutterhead assembly means about its horizontal axis;

(c) boom assembly means for supporting said cutterhead assembly means;

(d) boom carriage means for supporting said boom assembly means;

(e) sweep means mounted on said boom carriage means for sweeping said boom assembly means and said cutterhead assembly means horizontally from side to side;

(f) base frame means for slidably supporting said boom carriage means;

(g) thrust means mounted on said base frame means for thrusting forward said boom carriage means, said boom assembly means, and said cutterhead assembly;

(h) holding means mounted on said base frame means for holding said base frame means stationary when said thrust means is thrusting forward said boom carriage means and when said sweep means is sweeping said cutterhead assembly means from side to side; and

(i) transport means for transporting said base frame means.

28. The mobile mining machine of claim 27 further comprising:

muck removal means for removing cut rock from said cutterhead assembly means.

29. The mobile mining machine of claim 28 wherein said muck removal means further comprises a muck apron means and conveyor means for conveying the cut rock away from said cutterhead assembly means.

30. The mobile mining machine of claim 27 wherein said rolling cutter units are disc cutters about 10 to 18 inches (25 to 45 cm) in diameter.

31. The mobile mining machine of claim 27 wherein said sweep means mounted on said boom carriage means comprises hydraulic cylinders means mounted on said boom carriage means.

32. The mobile mining machine of claim 27 wherein said thrust means mounted on said base frame means comprises hydraulic cylinder means mounted on said base frame means.

33. The mobile mining machine of claim 27 wherein said holding means mounted on said base frame means comprises hydraulic gripper cylinder means mounted on said base frame means.

34. The mobile mining machine of claim 27 wherein said transport means for transporting said base frame means comprises crawler means mounted on said base frame means.

35. The mobile mining machine of claim 27 additionally comprising roof support means mounted on said boom carriage means.

36. A mobile mining machine for cutting mining tunnels in hard rock by horizontal sweeping movements and vertical ranging movements, comprising:

(a) a wheel-like cutterhead assembly means for cutting said hard rock, said cutterhead assembly means having a substantially horizontal axis of rotation and having multiple peripherally mounted rolling cutter units;

(b) rotation means for rotating said cutterhead assembly means about its horizontal axis;

(c) outer boom assembly means for supporting said cutterhead assembly means;

(d) inner boom assembly means for supporting said outer boom assembly means;

(e) sweep means mounted on said inner boom assembly means for sweeping said outer boom assembly means and said cutterhead assembly means horizontally from side to side;

(f) boom carriage means for supporting said inner boom assembly means;

(g) lift means mounted on said boom carriage means for vertically lifting said inner boom assembly means, said outer boom assembly, and said cutterhead assembly;

(h) base frame means for slidably supporting said boom carriage means;

(i) thrust means mounted on said base frame means for thrusting forward said boom carriage means, said inner boom assembly, said outer boom assembly, and said cutterhead assembly;

(j) holding means mounted on said base frame means for holding said base frame means stationary when said thrusting means is thrusting said forward boom carriage means and when said sweep means is sweeping said cutterhead assembly means from side to side; and

(k) transport means for transporting said base frame means.

37. The mobile mining machine of claim 36, further comprising:

muck removal means for removing cut rock from said cutterhead assembly means.

38. The mobile mining machine of claim 37 wherein said muck removal means comprises muck apron means and conveyor means for removing cut rock from said cutterhead assembly means.

39. The mobile mining machine of claim 36, wherein said rolling cutter units are disc cutters about 10 to 18 inches (25 to 45 cm) in diameter.

40. The mobile mining machine of claim 36, wherein said sweep means mounted on said inner boom assembly means comprises hydraulic cylinder means.

41. The mobile mining machine of claim 36, wherein said lift means mounted on said boom carriage means comprises hydraulic cylinder means for lifting vertically said inner boom assembly means.

42. The mobile mining machine of claim 36, wherein said thrust means mounted on said base frame means comprises hydraulic cylinder means mounted on said base frame means for thrusting forward said boom carriage means.

43. The mobile mining machine of claim 36 wherein said holding means mounted on said base frame means comprises hydraulic gripper cylinder means for holding said base frame means stationary when said thrust means is thrusting forward said boom carriage means and when said

sweep means is sweeping said cutterhead assembly means from side to side.

44. The mobile mining machine of claim 36 wherein said transport means for transporting said base frame means comprises crawler means mounted on said base frame means.

45. The mobile mining machine of claim 36 additionally comprising beam erector means mounted on said inner boom assembly means.

46. A mobile mining machine substantially as hereinbefore described with reference to Figs 1 to 5, Figs 6 to 9 or Figs 10 to 12 of the accompanying drawings.

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